Remarks:

Reconsideration of the application is requested.

Claims 1-33 remain in the application. Claim 1 has been amended.

In item 3 on page 2 of the Office action, claims 1-12, 14-16, and 24-26 have been rejected as being anticipated by or, in the alternative obvious over Tadatsu (JP 5-152609 A) under 35 U.S.C. § 102/103.

The rejection has been noted and the claims have been amended in an effort to even more clearly define the invention of the instant application. Support for the changes in claim 1 is found on page 32, lines 8-14 of the specification.

Before discussing the prior art in detail, it is believed that a brief review of the invention would be helpful.

The invention of the instant application relates to a light radiating semiconductor component that includes a light source that emits radiation in a first wavelength and a luminescence conversion material for converting the first wavelength into a second wavelength. The first and second wavelengths can be made to be complementary thereby giving off white light.

There are two basic embodiments of the present invention, each of the two basic embodiments having variations. The first embodiment is shown in Figs. 1-3, 6 and 10. As shown, the semiconductor component according to the invention includes a semiconductor body 1 having a layer sequence 7 (see Fig. 9). The body 1 is electrically coupled 11 to an electric terminal 2. A second electric terminal 3 is also electrically coupled to the body 1 via a bonding wire 14. The body, bonding wire, and portions of the first and second electric terminals are encapsulated in a luminescence conversion encapsulation 5. The encapsulation may be made of transparent plastic or resin and is treated with a luminescent material 6 (e.g. YAG:Ce). Alternative embodiments of the first embodiment include the addition of a lens covering 29 that is optically coupled to the encapsulation 5. Likewise, the encapsulation of luminescent material may be limited to the perimeter of the encapsulation (see Fig. 2) or perimeter of the body (see Fig. 6) such that the radiation emitted from the body has a substantially equal or uniform optical path length through the luminescence conversion element. Alternatively, the body, bonding wire, and portions of the first and second electrode may reside in a recess 9 formed by an opaque base housing 8. The recess may further be filled with a transparent plastic, glass or gaseous material. Again, the luminescent material 4 may be applied along a top surface cover plate 17 (see Fig.

3). Alternatively, the recess may be filled with luminescent conversion material 6 (see Fig. 10).

The second embodiment further includes a radial dome filled with a transparent material such as epoxy (see Figs. 4 and 5). The dome houses the body, luminescent material and portions of the first and second electrodes in basically the same way as the above housing. A reflector portion 16 is formed on top of the first electrode. The body is housed within a recess 15 in the top portion of the reflector. As above, the recess may be filled with a transparent material and the top perimeter of the recess may be coated with the luminescent material. Alternatively, the recess may be filled with the luminescent material. In the latter case, two bonding wires may be used to ensure electrical connection between the body and two electrical terminals. Lastly, in both embodiments, the encapsulation may include light diffusers.

Both embodiments have in common that radiation emitted by the body 1 travels a substantially uniform or equal path length through the luminescent conversion material. The uniform or equal path length ensures that the desired hue results from the luminescence rather than from imperfections which are associated with different length optical paths (see e.g. pages 32 and 41 of the specification). In addition, the amount of material or thickness of the material devoted to the

luminescent material is smaller than in the prior art. Therefore, smaller phosphor particles may be used so as to achieve a higher density packing thereby providing the same luminescence intensity as prior art embodiments which require a greater portion of the component devoted to the luminescent material. The tighter packing with respect to prior art devices restricts the effects of phosphor particle settling which also results in a hue degradation in the prior art embodiments. Finally, the tighter packing ensures uniform distribution of the phosphor particles thereby further ensuring a uniform emission.

In operation, only a portion of the wavelength emitted by the body is converted into the second wavelength. The overall emission of the above embodiments is the combination of the first and second wavelengths. By an appropriate selection of luminescent material, one can select the second, third or more wavelengths into which a portion of the first wavelength is converted. When the aforementioned wavelengths are complementary, the resulting light is white. Examples of such emissions are shown in the graphs of Figs. 7, 8, 11, and 12. As will be explained below, none of the cited prior art references makes use of the combination of the two above-mentioned wavelenghts.

Tadatsu discloses a resin dome shaped LED 4 encapsulating a light emitting body 11 disposed in a cavity positioned atop of a first terminal and electrically connected to the first and a second terminal via bonding wires. The encapsulation is filled with a fluorescent dye 5. The dye is excited by emissions from the emitter 11 to produce light. The dye is dispersed throughout the dome having a non-uniform thickness and thus the path lengths of the radiation through the dome have <u>different</u> lengths.

Clearly, Tadatsu does not show or suggest the limitation of a luminescence conversion element formed such that the radiation of the first wavelength range passes through the luminescence conversion element along a plurality of paths, the plurality of paths having a <u>substantially equal path length</u> inside the luminescence conversion element, as recited in amended claim 1. As a result, the device of Tadatsu lacks the above-described advantages of a uniform emission and an improved hue quality.

Tadatsu also does not disclose or suggest the use of a combination of a first and a second wavelength in order to generate a white light emission. As explained above, the present invention's source radiation is only partially absorbed by the luminescence layer. The layer produces a second emission wavelength which is complementary to the

source wavelength (first wavelength range). The first and second emissions are combined to produce an overall emission that resembles white light. Tadatsu makes no mention or suggestion of such a device for generating white light. Tadatsu generates white light by a radiation source stimulation of a fluorescent pigment or dye 5 only. No source emission is used in the final white light emission. The subject matter of claim 1 is therefore believed to be patentable over the disclosure of Tadatsu.

In item 4 on page 3 of the Office action, claims 1-33 have been rejected as being unpatentable over Tadatsu in view of Geusic (U.S. Patent No. 3,593,055), Mita (U.S. Patent No. 3,932,881), and Pinnow (U.S. Patent No. 3,691,482) under 35 U.S.C. § 103.

None of the references shows or suggests the limitation of the combination of the first and second wavelength for producing white light or the limitation of the luminescence conversion element being formed such that the radiation of the first wavelength range passes through the luminescence conversion element along a plurality of paths, the plurality of paths having a substantially equal path length inside the luminescence conversion element, as recited in amended claim 1.

Geusic discloses three embodiments of an LED. Each of these embodiments includes a phosphor layer for a maximum absorption of infrared radiation emitted by a pn junction source. The IR source is encapsulated and the phosphor layer is provided above or around an encapsulation. The encapsulation is dome shaped so as to provide a tangential incidence of the IR light upon the phosphor layer (see Fig. 1). For a maximum visible emission based on the absorption and total luminescence of the IR source, a minimum thickness of the phosphor layer is required, along considerations on how to form the dome. Where such a minimum thickness is not economical or practical, a second layer (see Fig. 2, reference numeral 15 and/or 23) may be coated on top of the phosphor layer. The second layer passes visible radiation while absorbing or reflecting IR radiation (see col. 4, lines 46-63). Finally, a third embodiment takes further measures to address the problem of an incomplete total absorption of the IR radiation. Here, a dome shaped encapsulation of an IR source 33 passes IR radiation into a phosphor layer 31 housed in an internally reflecting housing 35. Not all of the IR radiation is absorbed by the phosphor layer, therefore a second dome 30 is placed on top of the housing 35 to effect an additional IR absorption while passing visible radiation.

Firstly, the device of Geusic is configured for a <u>total</u> absorption of the source radiation by the luminescent layer.

In contrast thereto, the invention of the instant application is intended for a passage of a significant portion of the source radiation so as to combine it with the luminescent layer emission thereby producing a selected visible emission. Geusic teaches away from the configuration of amended claim 1, and clearly does not anticipate or make it obvious to provide the combination of features defined in claim 1. Second, Geusic teaches the use of one luminescent layer to absorb <u>all</u> of the source radiation such that the total spectrum of the emission is produced by the luminescent layer, which is clearly different from the use of a combination of two different wavelength ranges.

The Examiner uses Mita only for teaching "encapsulating layers with different luminescent properties with dome design" and the "10 micron particle size which is effective as a diffusing agent". Mita discloses a structure that is similar to the structure of Geusic, namely, an encapsulated light source 34, 31 providing infrared emissions onto a phosphor layer 38 and the phosphor layer converting the IR emissions into visible light. A single large body 33 houses the phosphor layer and the encapsulation in an internally reflecting cavity 36 such that the phosphor layer receives a maximised amount of infrared radiation from the encapsulation (see col. 4, lines 25-50).

Pinnow is directed to a display system which uses combinations of phosphors which upon laser stimulation emit white light. The Examiner uses Pinnow to show the use of YAG:Ce phosphor. The configuration of Pinnow is completely different from an LED as defined in amended claim 1. Furthermore, the laser light is not used as part of the final light emission, the laser light is only used as a stimulation source for a phosphor screen.

Clearly even a combination of the cited references cannot suggest the luminescence conversion element as defined in amended claim 1.

In item 5 on page 3 of the Office action, claims 1-33 have been rejected as being unpatentable over Tadatsu in view of Mita, Pinnow, and Geusic and further in view of Sato et al. and Chao et al. under 35 U.S.C. § 103.

Neither the Office action nor the Notice of References Cited (PTO-892) identifies the reference of Sato et al. with a patent number or the like, therefore, applicants can only respond to a combination of references including Tadatsu, Mita, Pinnow, Geusic, and Chao et al.. Chao et al., like the other prior art references, relies on a flourescent layer only, namely a specially doped glass, to emit white light based on radiation stimulation from a source. Clearly, the

source radiation is not combined with the emission from the luminescence layer (in this case the doped glass) to produce a white light emission based on such a combination. Rather, similar to the other references, Chao et al. rely on particular combinations of flourescent particles to produce a desired emission when selectively stimulated. Therefore even combination of the references fails to teach the luminescence conversion element of amended claim 1.

In item 6 on page 4 of the Office action, the Examiner rejected claims 1-4, 6-10, 13, 17, 21-23, 25, 26 and 28-33 as anticipated by, or alternatively, as obvious over Abe (U.S. Patent No. 5,535,230) under 35 USC § 102(e)/103(a).

Abe discloses two embodiments of a light source (see Figs. 1a and 1b). The first embodiment includes two semiconductor laser sources 1 mounted in a heat sink 2. The output from the lasers pass through a diffusing lens 3 en route to a fluophor 4. The fluophor is coated on the inside wall of a vacuum tube 5 which is charged with argon gas. The diffused laser light L1 excites the fluophor which produces the white light emission L. The laser light is not a component of the white light (see col. 4, lines 17-38). The second embodiment includes three semiconductor lasers IR, IG, IB whose light is also passed through a convergence lens 9, a collimator lens 8 and a diffusion lens 3. The combined output alone results in

white light emission. In the second embodiment there is no fluophor or other luminescence element.

The Examiner stated that "Abe shows a light emitting diode in an arrangement with wavelength conversion fluors for emission of white light." Clearly, Abe does not show or suggest a luminescence conversion element with at least one luminescent material, the luminescence conversion element converting a radiation originating in the first wavelength range into radiation of a second wavelength range different from the first wavelength range, such that the semiconductor component emits polychromatic radiation comprising radiation of the first wavelength range and radiation of the second wavelength range, as recited in amended claim 1. In other words, Abe fails to teach or suggest the configuration as claimed wherein the first wavelength is from a radiation source and the second wavelength is emitted by a luminescent layer stimulated by the radiation source. Rather, Abe discloses a light source using a plurality of lasers which either emit themselves all the necessary components for white light emission or stimulate fluophor to create the entire white light emission with the fluophor.

It is accordingly believed to be clear that none of the references, whether taken alone or in any combination, either show or suggest the features of claim 1. Claim 1 is,

therefore, believed to be patentable over the art and since all of the dependent claims are ultimately dependent on claim 1, they are believed to be patentable as well.

In view of the foregoing, reconsideration and allowance of claims 1-33 are solicited.

Petition for extension is herewith made. The extension fee for response within a period of three months pursuant to Section 1.136(a) in the amount of $870.00 in accordance with Section 1.17 is enclosed herewith.

Please charge any other fees which might be due with respect to Sections 1.16 and 1.17 to the Deposit Account of Lerner and Greenberg, P.A., No. 12-1099.

Respectfully submitted,

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For Applicants

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